

Pray (J. J. W.)

With Com. Elements of Winter

an
"THE ETIOLOGY, NATURE, CAUSES, ETC., OF DIPHTHERIA."
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AN ADDRESS

DELIVERED BEFORE THE

N. H. MEDICAL SOCIETY,

AT ITS

Ninetieth Annual Session,

HELD

AT CONCORD, N. H., JUNE, 1880.

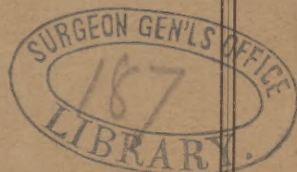
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BY T. J. W. PRAY, M. D.,

OF DOVER, PRESIDENT OF THE SOCIETY.

CONCORD :

PRINTED FOR THE SOCIETY BY EVANS & SLEEPER.

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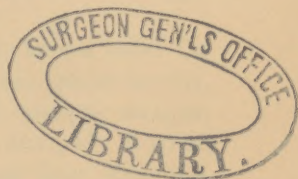
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PRESIDENT'S ADDRESS.

Gentlemen of the N. H. Medical Society :

I shall travel out of the accustomed paths, in addressing you to-day. Instead of considering some general topic, as has been the custom in this society, which may or may not have any practical bearing upon our daily duties, I have chosen a theme somewhat intricate, about which there is a wide difference of opinion, but of such importance that it must be of interest to each one of us. I do not claim anything new upon the subject, but I hope I have brought together facts that may lead to a further elucidation of "THE ETIOLOGY, ^{as} NATURE, CAUSES, ETC., OF DIPHTHERIA."

No malady in ²this country, if we except yellow fever, has awakened a deeper interest among all classes of society than diphtheria. Its fearful ravages among the comparatively robust, as well as the weak ; its visitations in the habitations of the wealthy, as well as in the abodes of squalid poverty—sparing neither age, nor social condition in its deadly onslaught—have produced the deepest solicitude how to ward off its attacks. Then the victims of this pestilential disease, among whom it delights to revel, are children of tender years, upon whom the fond parent has centered bright anticipations for comfort and future happiness.

Diphtheria has existed for ages. It has been known under the names of *Syrian ulcer*, *Askara*, *morbus suffocans*, *gullae morbus*, *garrottillo*, *para cynanche*, *malum Egyptiacum*, *cynanche maligna*, *angina gangrenosa*, *cynanche trachealis*, *croup*, *hives*, etc. It is not, then, a visitor of the present century, as some have supposed. Away back in the early ages of Greece and Rome, there can be but little doubt of its prevalence, for diseases are frequently alluded to which affected the throat, and were dangerous to life Aretaeus,

a Greek physician of Cappadocia, who flourished, probably, in the year A. D. 80, speaks of a disorder which became epidemic, where the mucous membrane of the pharynx had ulcerated surfaces "foul, and surrounded with a black, livid, or white crust; and patients thus affected die in a few days of fever and inflammation, accompanied with fetor, ichor, cough, and difficulty of breathing." In 380 a disease broke out in the imperial city of Rome, which Celsus styled *para cynanche*, analogous in character to diphtheria. Coelius Aurelianus, at the close of the third century, wrote of an ailment where there was a "barking" sound of the voice, a stredulous breathing, suffocation, lividity of the face, and, while in the act of swallowing, fluids passed into the nose. In the sixth century, Actius, of Amida, mentions a trouble of the tonsils where there were white and ash-grey exudations.

History is silent about diphtheria for a long number of years, until about the middle of the fifteenth century, when it appeared in Holland. From this date, we have exact and accurate descriptions. Soon after, it was noticed in Spain, and went under the name of *garrotillo*. In the sixteenth century, so fearful were its ravages in Naples, that in a few months five thousand fell victims. In 1743, it broke out with violence in Paris, and a large number of those attacked died. Sixteen years afterwards, Dr. John Fothergill, of England, speaks thus of this disease,—“The sloughs are not formed of any foreign matter spread over the parts affected, as a crust or coat, but are real mortifications of the substance.” Dr. A. Philip Wilson, of Scotland, in the later part of the seventeenth century, or the first part of the present century, alluding to the exudation upon the fauces, writes,—“They soon assume a dark red color, and specks of some shade between a light ash color and a dark brown appear, scattered over the tonsils, *velum pendulum palati*, and *uvula*. The lighter the color of the specks, the better the prognosis.” He terms the disease (“*Treatise on Febrile Diseases*,” by A. P. Wilson, page 157) “*cynanche maligna*.”

In the United States, the first mention of this ailment was in 1771, by Dr. Samuel Bard, then professor at Columbia College. He says,—“In general, it was confined to children under ten years of age, though some few grown persons, particularly, had symptoms very similar to it. Most of those who had it were observed to

droop several days before they were confined to bed. Such as could speak, complained of an uneasy sensation about the throat. The tonsils were swelled and slightly inflamed, with a few white specks upon them which increased to one general slough." It was a highly dangerous disease, and yet he remarks,—“There was only one child in which I could discover anything like a disagreeable smell, either from the breath or expectoration.” His cases could not have been of a severe malignant type. In 1798 Dr. John Archer published a paper on *cynanche trachealis*, in which he distinctly portrays diphtheria.

But it is not until we arrive at comparatively modern times that we find diphtheria claiming the attention of medical men as a distinct disease. Bretonneau, in 1821, was the first who gave it a nosological classification. He had observed that there was a disorder generally confined to the pharynx and adjoining parts, where there was a false membrane, and it assumed an epidemic form. He believed he had discovered a new disease, and denominated it diphtherite, from the Greek word *διφθεζια*, denoting a skin or parchment and *itē*, the well-known termination to imply the existence of inflammation. This name was subsequently changed by Trousseau to diphtherie, to get rid of the idea that its cause was due to inflammation. Since this time it has been known, both in Europe and America, by the name of diphtheria.

For the last sixty years, medical literature has been teeming, now and then, with descriptions of the terrible devastations which the disease has made throughout the civilized world. Its virulence has not abated in the least, but, rather, since 1858, seems to gather new strength as it moves from one place to another. At the present moment,—autumn of 1879,—in Russia its fatality is terrible. In many portions of that country, it has attained such frightful proportions that the percentage of mortality exceeds that of births. In some small districts, from one half to seventy per cent. of the infant population have died. In the hamlet of Nakomobka, two hundred children succumbed to the disease in about ten months, in addition to a large number of adults. In the village of Tamorofka, not one child escaped the epidemic.

But however interesting it might be to trace the workings of diphtheria, as it has been seen in the civilized world, our purpose

would not be answered in so doing. Let us here remark, that in the United States, after Dr. Bard's brochure, there is a silence for nearly a century in regard to its existence, until it broke out in 1831, as an epidemic, at Philadelphia. In 1839, Dr. Geddings, of South Carolina, published (*American Journal Medical Science*, 1839,) an excellent and graphic monograph, in which he states that this affection seizes not only the throat but "the remote portions of the body,—the external meatus of the ear, folds of the groin, contour of the anus, and upon those parts wherever there was excoriation of the skin. In 1842 there was an epidemic in Augusta, Ga. (report of Prof. Dugas, 1879). Medical journals occasionally speak of it as existing, but it was not until 1856 that it was generally recognized. It then became known in the Southern, Western and New England portions of this country, under the name of diphtheria. Dr. Force,* of Kentucky, says, "in his practice, begun sixteen or seventeen years before, he did not meet with a single case." In Wilmington, Del., Dr. Bush* remarks, "that from 1849 to 1860 only nine cases of throat diseases were reported in that city, none of them under the name of diphtheria." There has been an increase of this disease since 1857, or before that time the causes producing it must have been less operative, or it must have been recognized by some other name. This is the attestation of other physicians. As far as information can be gained, it prevails more extensively in the northern than in the more southern states, and yet epidemics are reported now and then in the latter, among all classes of society. From statistics, the white population are more prone to the disease than the colored. Dr. Lawrence, of Hot Springs, Ark., says, "there is almost an entire immunity from diphtheria among the pure bred Africans." The vital statistics of Wilmington, Del., 1877, show the proportion of white and colored cases,—six of the former to one of the latter.

ETIOLOGY.

Diphtheria is a constitutional disease, often of an endemic and epidemic character, originating in some miasmatic influence taken into the system. It is generally attended with local manifestations in the faucial regions, of a whitish, or gray ash colored membrane

* Private letters from Dr. Force and Dr. Bush.

spread over the posterior part of the roof of the mouth, the uvula, tonsils into the posterior nasal passages, Eustachian tubes, often along the trachea, bronchæ, the œsophagus, and even extending to the stomach. The disease is sometimes of an adynamic type, accompanied with more or less disturbance of the renal functions, enlargement of the cervical glands, and frequently terminating in temporary lesions of the nervous system.

The word, diphtheria, is often used vaguely, sometimes denoting a thin almost transparent whitish exudation of the pharynx ; sometimes gray yellowish spots upon and within the mucous membrane ; sometimes naming a hyperaemic state of the mucous membrane, with here and there scattered spots of exudations, diphtheritis, and calling that affection with severe febrile actions, fetor of breath, swelling of the glands of the neck and the presence of albumen by the same name. No local exudation of the pharynx is deserving the name unless there is constitutional derangement, or symptoms which constitute such phenomenal prominence as would indicate its presence, and yet the term is used when there is a mild catarrhal state, when there is an inflammatory condition of the mucous membrane, characterized by active hyperaemia, and when there is no visible membrane to be traced in the pharynx. The disease may be suspected when there are infectious or contagious tendencies, whether there is a membrane or not. There are some appearances of the fauces where a membrane is present, partly adherent and partly not, which seem to have a diphtheritic tendency, but such cases are not accompanied with but little constitutional disturbance, and can hardly be classed as diphtheria. The tendency of mucous membranes, when irritated or inflamed, is to throw out a whitish exudation. Such states are not always diphtheritic, although large patches of membrane exist.

ANATOMICAL APPEARANCES.

In the commencement of diphtheria, there is more or less constitutional disturbance, redness of the mucous surface of the pharynx—the parts are fuller with enlargement or thickening of the faucial membrane. Quite often, in the course of a few hours, the upper part of the throat becomes involved with a color varying from a deep red to that of a darker hue. The uvula is often

elongated and enlarged from a watery infiltration, the tonsils are affected and the adjacent parts sympathize, become swollen and painful. From one to three days after the prodromatic symptoms have commenced, a slightly raised patch, or small points are seen on the posterior part of the fauces, or on the tonsilar region. These soon coalesce and often extend over the entire pharynx. This patch, termed the pseudo-membrane, soon becomes firmer and thicker from fresh exudations underneath, or, as some maintain, from enlargement or sloughing off of the necrosed epithelium. This membrane is tough, two or three lines thick, and is of a gray, or grayish white color. In some instances, the disease appears by preference upon those parts already inflamed. Denuded surfaces of the skin in the progress of the disease, as burns, blisters, or wounds, often become diphtheritic; other parts of the body, as the vagina, contour of the anus, external meatus of the ear, &c., have often an exudation similar to that seen in the fauces.

The common view is that this apparent exudation is of a fibrous character closely attached to, and penetrating into the surface of the mucous membrane, and not easily detached therefrom, and on this account it is unlike membranous croup, in its being more firmly united to the mucous membrane of the fauces. Attempts to separate it often lacerate the parts and produce irritation and bleeding. Virchow was the first who promulgated this supposed distinction between croup and diphtheria, by affirming that the membrane could be easily cleared off in the former, and not in the latter disease. But since that announcement, he has acknowledged his error and confesses that this asserted difference does not hold true in particular instances. Whenever the separation is not easily effected, it is due to the difference of the epithelium of the pharynx and vocal cords, and that of the nasal passages and larynx, the one being basement, and the other generally ciliated epithelium. He found that no line of demarcation could be made between the membranes of the two diseases, and then he took the ground that there is no exudation but the tissue elements, especially the cells, being quickly filled with a cloudy substance, are destroyed by a fatty metamorphosis, and then necrobiosis follows. Jones and Sieveking are also of the opinion that the exudation is in fact a part of the mucous membrane, partially made up of ne-

crotic sloughing tissue. "This character of necrosis is the only distinguishing one of diphtheria." Wagner, whose authority is unquestioned, declares that the two are very much alike and the network in both has its origin in a peculiar fibrous degeneration of the epithelium, and not in the separation of coagulable fluid from the blood. Rindfliesch admits the pathological process in "pharyngeal croup" and "laryngeal croup" are the same. The microscope only shows chiefly necrotic tissue, and reveals no difference of any moment in the two products. There are certain cells resembling coagulated fibrin altered by inflammation, and contain solid infiltrated matter, fused together in various directions, so as to have the appearance of branching tissues. The superficial cells, being the largest, decrease in size until they seem to merge into the normal cells. In the course of the disease, pus cells or free nuclei form in large quantities between the mucous surface and the false membrane, and then a final separation occurs between the two. The apparent exudation soon disappears in consequence of the softening of the cells, which become fatty and granular, and degeneration of a gelatinous character takes place.

There is a wide difference of opinion among medical writers in regard to diphtheria and membranous croup, aside from their pathological characteristics. Many observers, as Bretonneau, Sir William Jenner, and others of equal fame, have claimed the identity of the two diseases, while Home, Buhl, and others in Europe and the United States, contend with equal vigor that the two affections are unlike and produced by different causes. It must be confessed that cases of croup are rarely met with now-a-days, because almost every membranous appearance is now classed as diphtheria. "Croup," writes Professor Hurd, of Texas, "is the exception to the general rule in this state." The same remark has been made by others. The word has been used vaguely, both by the public and the profession, to describe difficulty of breathing, and a certain train of laryngeal symptoms. Strictly speaking, croup is not a disease, but a symptom. The term has no pathological significance. Most French physicians give this name to the membranous sore throat, which is the local manifestation of a general disease called by Trousseau, diphtheria. If the term is to

be retained, it should be applied to stridulous breathing, a symptom common to quite a number of other affections.

The tendency of modern medical thought is to drop altogether the term croup, and substitute that of laryngeal diphtheria. There can be but little question, that membranous inflammation of the larynx and the trachea is in a vast majority of cases diphtheritic. If the conditions of the mucous membrane beneath the pathological products be examined, both in croup and diphtheria, it is the same ; and a similar state of the tissues is sometimes encountered. But some give the appellation of croup to the inflammation confined to the trachea and larynx, and diphtheria where the pharynx is first attacked. But this supposed distinction cannot hold, as there are cases where the disease has been so limited, and yet they were traced to infection, conveyed by impure air and water. An instance (Medical Times, London, 1879.) is related where sewer gas escaped into the ward of a hospital for children, and this produced in one pharyngeal diphtheria, and in another laryngeal diphtheria, in which the membrane was located below the epiglottis. Difference of site in constitutional diseases does not imply a specific difference. Cancer, wherever located, is the same. It seems quite improbable that there are two kinds of pellicular inflammations, one in which the cause is diphtheritic poison, and the other arising from some other undefined influence. The truth is, what is termed membranous croup is not confined to the larynx. It often commences in the pharynx, and only in ten to fourteen per cent. of cases does it originate in the former. We have seen cases of membranous croup begin in the nasal passages, then seize the fauces and creep down into the larynx and trachea. There could be no mistake about the diagnosis. The membrane was white ; there was no odor, no asthenic symptoms, nor any of the phenomena which are supposed to separate, clinically, the two diseases. Diphtheria, likewise, often commences its point of attack in the nasal passages, and travels downward into the larynx, simulating croup in its mode of progress.

If there is any distinction between the two affections, it must be found in their clinical features, and these are generally classed as follows, viz :

Diphtheria is

Adynamic type.
 Enlargement of cervical glands.
 Albumen in urine.
 Occasionally paralysis.
 Eudemic and epidemic.
 Contagious and infectious.

Croup is

Sthenic.
 No enlargement.
 No Albumen.
 No paralysis.
 Sporadic.
 Not infectious.

These supposed distinctions, of course, are more marked in some instances than in others. In many cases of membranous croup, it is quite difficult to draw the line of dissimilarity from diphtheria. The two affections seem to run into each other. There are but few examples of sthenic croup. Bleeding has been resorted to even in both croup and diphtheria. Simorre (*Courier Medicafe*, 1878,) has reported 53 cases of diphtheria thus treated, all of them recovered, most of them in twenty-four hours, but we do not think venesection can be well borne in either disease.

Difference of type, then, cannot have much weight to distinguish the two affections. Many cases of diphtheria are very mild, virtually non-infectious, and they are easily cured. Indeed, their tendency, from the first, is toward health, and they do not, in any way, assume adynamic symptoms. Neither is the fact that the cervical glands are enlarged in one instance, and not in another, of great value as a differential sign. Glandular swelling is not necessarily present, where there is a membrane of the throat. In other affections of this region, and inflammation thereof, the superficial glands of the neck are frequently irritated. Cancer has a tendency to increase their size when situated in the fauces, but in the larynx it has no influence over them. As to albumen, it is seen in croup as well as diphtheria. Dr. Dickinson (*Medical Times*, London, May, 1879,) reports forty-nine cases of croup, out of sixty-three, where this was present, and one, out of seventeen, in non-membranous croup. In regard to paralysis, croup almost always terminates fatally before this symptom appears, and therefore this cannot be claimed to exclusively belong to diphtheria, or to be of any diagnostic importance, and yet cases are recorded of those who have recovered from this ailment with paralysis of some part of the body. Then, in the matter of contagion and infection, there cannot be drawn any line of separation, since both diseases so imitate each other in appearance and history as to make it difficult, if

not impossible to distinguish between them. (See *London Lancet*, Nov. 1879, p. 675.) Hence the reason that many name cases of laryngeal diphtheria, croup, and croup diphtheria. There can be no doubt that membranous affections in the larynx and trachea are often contagious. Malignant and putrescent diphtheria can always be considered infectious and contagious. But it will be said, that croup differs from diphtheria in its character and manifestations. The latter often attacks the Eustachian tubes, extends to the internal ear, and from the nasal passages into the eyes, and even reaches to other parts of the body. Croup never manifests itself thus. Our answer is, in many persons the mere scratch of a pin on any part of the body produces grave consequences; in another, this would have but little effect; so there is a difference in the manner or progress of a common sore throat. In one person, it is slight; in another, it is more extensive and causes greater suffering. Likewise in membranous affections, sometimes the membrane is confined to a small portion of the faucial region; in others, the tendency of it is to spread in every direction, forward over the roof of the mouth up into the nasal passages, &c. The disease from the onset assumes a gangrenous character, and there is so little apparent vitality in the parts that nature is unable to stop its spread. Now no one will pretend to say that the cause in these examples is different, but the varying results are due to the idiosyncrasy of individuals to different constitutional diathesis, and to the inability to withstand the attacks of any violent disease. But we will not pursue these supposed points of difference further.

True diphtheria, both laryngeal and pharyngeal, has the ability to communicate its poison to others. It is contagious in some degree, but not so much so as many other specific diseases. In mild cases, where there is but little constitutional disturbance, this disposition is but little felt. Single cases of this character are often noticed even when there is no isolation of the sick. This disease is communicable by means of a vitiated atmosphere and the excretions of the sick. Whole families will be stricken down when once it has entered their dwelling. The more virulent the attack, the more vitiated the surrounding air, the greater liability to infection. It develops very rapidly under the influence of poisonous miasms. Clothing becomes tainted with its infectious nature. It

can be conveyed from one house to another. One sick at a long distance may be the vehicle of producing a violent epidemic of this disease in another place. The case* reported by Dr. Spear, of Maine, in the *New York Medical Record* (July 1875), cannot be accounted for in any other way, except the disease be infectious. Here a shawl was borrowed from an infected house, and taken to another, where there was no disease. In a few days afterward two children in the latter place (which was some distance from the first) became sick with diphtheria and died. There had been no other communication with the first named family. Dr. Thursfield, of England, has reported a very remarkable instance where a non-infected person, living in a house where the disease had been, walked some distance, crossed a ferry, and spent a few minutes in another house. But she was there long enough to leave the germs of disease, as diphtheria broke out with violence a few days afterwards. Dr. George Johnson, of King's College, England, relates the following instance: "A girl aged fifteen years, after having been ill for ten days at a school, returned to her home. It was noticed that for some days after her arrival, she had a discharge from her nostrils. As no warning had been given that she had been suffering from an infectious disease, she was allowed to associate with her seven brothers and sisters. After she had been a week at home the school-mistress wrote to say, 'that she felt anxious to hear of her pupil, as there had been cases of diphtheria at the school.' In about another week, a sister aged ten and a brother aged four were seized, within a day or two of each other, with symptoms of diphtheria, and in a few days they both died. The other children were isolated as soon as they sickened, and no other cases occurred." So confident are sanitarians of its contagious and infectious nature that they recommend isolation of the sick in all cases. Not only so, but this infection clings to the walls of papered rooms for a long time. I had recently under my care a patient, a father who was quite sick with diphtheria. His daughter, about three years of age, usually slept in a small room with the father and mother. She was not allowed, during the parents illness, to go

* Proof that the disease may be spread through infected clothing, can be found in the replies of Drs. Clapp, Young and Swift in the Report of Michigan Board of Health, 1878.

into the sick room. I recommended, after his recovery, that the bedding be disinfected, the room be cleaned, with the remark at the time, "if you do not do this your little daughter will surely take the disease." This was not done however, as thoroughly as directed. In less than five months (the disease not existing as an epidemic or even sporadically) the little one violently sickened, and after a few days died. I have no doubt that the cause of her disease was due entirely to the infection kept alive, it may be, in the walls of the room or the bedclothing.

The poison of diphtheria is carried by the ordinary channels of infection. Its tendency is to spread more at one time than another. It enters the system through the water drank and the food taken. Without doubt it is communicated by inoculation, as the deaths of Henri Blache and Valleix prove. A physician of our acquaintance came near losing his eyesight from a child coughing and some of the expectoration falling into his eyes. The mere breath, or the act of kissing the sick, has been productive of this affection. The secretions of the sick may pass into drains holding the germs of disease in suspension and be taken into the system whenever a favorable condition of the atmosphere and system supervenes. Moreover, infection can be taken from a corpse and its adjuncta.

PERIOD OF INCUBATION.

Sometimes it is difficult to arrive at a correct conclusion how long diphtheritic poison remains in the system before symptoms of the disease appear. In four cases recently under our supervision, after the first child sickened it was four days before the two others were attacked, and, eight days afterwards, the fourth was taken sick. Generally the period of incubation is from two to ten days, but often the poison may remain dormant for weeks before it becomes active. In one case, the disease occurred in fourteen days after exposure. Dr. McKenzie, of England, records a case of a young lady, who insisted, contrary to the advice of friends, in paying a visit to her cousins in London, who were convalescing from an attack of diphtheria. She spent two hours in their society, and in fifteen days afterward, she was taken sick. Prof. Smith, of New York, says, "the incubation of diphtheria, like that of scarlet fever,

varies in different cases. It is from two to eight days, with perhaps an occasional case outside of these limits."

NATURE.

Diphtheria resembles scarlet fever in some particulars, since the two diseases are seen in the same habitations, one following the other; and in its variability of type from a mild to a malignant form. Scarlet fever always furnishes conditions favorable for its occurrence. In its etiology it would seem to have some relation to typhoid fever, as both diseases arise from foul exhalations and sewer gas. Dr. Thursfield, whom we have before quoted, states (London Lancet, 1878), there is a connection between the two. He has observed epidemics of both affections occurring at the same time, the one around a town, and the other within, and not a case of typhoid fever without, nor a single instance of diphtheria within, that "diphtheria everywhere prevails inversely to typhoid fever, to which it is closely allied," although an attack of the latter affords no protection from a subsequent attack of the former disease, and that diphtheria may be disseminated in the same channels as typhoid fever. We noticed recently a corroboration of the statements of this writer. In a row of houses lately built on a gradual rise from the embankment of a river, the topmost of which was about forty feet above the river bed, diphtheria broke out in January, 1878, and there were five malignant cases. Soon after, the family in the next house had cases of the disease, and so on to the last, where it did not appear. In the next month five severe cases of typhoid fever occurred in the house next the river. This building was situated about two or three rods from the water, where the refuse of the three double houses was thrown and their sink drains emptied. The stench therefrom was quite disagreeable at certain times.

What then is the cause of diphtheria? There are two theories at the present time which divide medical opinion, that attempt to explain its phenomena, viz: that the disease is at first local by the presence of bacteria, and then constitutional symptoms intervene; and second, that it, from the first, is constitutional through blood poisoning, and that the diphtheritic membrane is only one of its manifestations. While neither of these theories may change the

ultimate results of the disease, still in matter of treatment it becomes quite important, for remedies addressed to the destruction of the vegetations found in the pharynx hold a chief place in its medication. Trousseau recommends to attack the pseudo-membrane with what he denominates "savage energy." The bacterian theory, without doubt, has had its influence on practice, and yet the experience of every physician is teaching him daily that, in grave cases, local measures, however early or perseveringly enforced, do not protect the system or prevent the occurrence of unmistakable symptoms of general infection.

The bacterian theory briefly stated is, that certain vegetable organism or monads attack the faucial regions, because there is the most fit place for their lodgement and growth, and through some unknown action cause, first, an exudation, and then, by septic influences, poison the blood and create general disturbance of the system. There are four genera of these bacteria recognized by pathologists, viz: the spherical, rod-like, cork-screw shaped, bacteria, and then a large species known as cocci with sprouting cells, with tube shaped processes, and with one or two small waving processes. This is Oertel's classification, who is considered the representative advocate of this theory. His opinion is that diphtheria cannot exist except through the presence of these bacteria or, as he sometimes calls them, "micrococci." "The vegetations," he remarks, "in the pathological products of diphtheria, consist principally of spheroid bacteria (the micrococcus), accompanied by a larger or smaller number of bacterian termo, represented always by the smallest number known, and this occurs so constantly that in every part when a diphtheritic infection has appeared, then the tissues and exudations are filled with these bacteria." Again he says: "If the disease increases in intensity, we can always demonstrate a progressive increase of these organism in the infected parts." Eburth is positive that "without micrococci there can be no diphtheria."

The germ theory has found quite a general acceptance among German physicians, and if we take into consideration the ability of its advocates, we have to confess that all objections to it should be carefully weighed. There can be no doubt that bacteria exist frequently in diphtheria, yet there has been no plausible explanation

how these vegetations get to the pharynx, nor in what manner they produce the local results. Ordinarily they excite no deleterious influence over the normal conditions of the system. When investigation has revealed that certain fungi in the diphtheritic membrane are harmless and are seen in healthy operations of the system, refuge has been to other forms, as, for instance, the bacterian term, to bring the borders of the invisible into perceptibility. The methods to show that bacteria produce local disturbance, have not always been logical. The investigations have begun at the termination of the disease, or when the disease has been sometime in progress, to prove what the disease is. They should have been aided or supplemented by clinical observations. The conclusions are often grasped at without proper authentication. As well take the contents of the ulceration of Peyer's glands, in typhoid fever, and finding bacteria there, reason that these were the causes of this fever. It is an humbling admission that there are but few epidemic diseases whose origin is positively assured. We cannot isolate the unknown substance or form which creates such wonderful action upon the system as is seen in variola, or the minute particle of infection which permeates the body and gives potency to its hideous deformities. All we do know, in our present state of knowledge, is some of the conditions under which diphtheria is developed. From a scientific standpoint, much of its declared etiology must be rejected because it has not been demonstrated as true, or even probable. In a practical point of view, however, it is of the utmost importance to know everything about its history, and the researches of others, if we would learn its nature and avoid its terrible consequences.

Now the majority of the supporters of the bacterian theory rely chiefly upon pathological experimentation to determine the character of diphtheria. If this be disproved or shown to be groundless, then its claims as a local disease are at an end. At the outset, it is quite singular in the investigations in this direction, scarcely more than one or two eminent microscopists agree or have arrived at the same conclusions. One kind of fungus is often claimed to be found, and then that particular kind will be denied to exist by the observations of another investigator. And then success is not always attained. Trousseau, Peter, Duchamp, and

others inoculated themselves with diphtheritic matter, and negative results followed ; while on the other hand, Oertel and Hueter have formed what is supposed to be the pseudo-membrane of diphtheria, by planting a portion thereof upon the mucous membrane of the throats of rabbits. The animals died in two or three days afterwards, with symptoms of general infection. Although in some instances a false membrane was produced, it may have been caused by decomposing animal matter. Take any suppurative process, in some states of the system, and, in quite a number of cases, local irritation would ensue, and there would be general disturbance of the animal economy. It therefore cannot be considered proved, that true diphtheria has yet been artificially produced by inoculation of the lower animals, though certain interesting phenomena have been produced.

Oertel states the bacterian termo, or micrococci, never present in simple inflammation of the fauces, but as soon as the diphtheritic process sets in, then this species makes its appearance and displaces the other forms of bacteria previously present. But this writer has been directly controverted in his position by M. Chanveau, who found the growth in diphtheria to present no difference from those observed in vaccina and variola. Senator (Duchamp, Thèse de Paris, 1875, No. 339), has observed in diphtheria, the *leptothrix buccalis*, a harmless fungus seen in health. He considers the minute bodies, or micrococci, of Oertel, to be spores of the *leptothrix*, and that the same fungi are found in aphthous, and mercurial stomatitis. Dr. Beal of England, who ranks as one of the best microscopists of that country, maintains (Disease Germs, 1872, London,) "that vegetable germs are observed in every part of the body of man from the earliest age, and in all stages of health. Millions of them are always found on the dorsum of the tongue and in the alimentary canal, and that active bacteria introduced among the living matter of healthy tissues will die, although the most minute germs present, which escape death, may remain imbedded in the tissue in a perfectly quiescent state, and that there are a few morbid conditions that are unquestionably solely due to the growth and multiplication of vegetable fungi."

It would almost seem that bacteria are only the vegetations of decay. Where decomposition reaches there is seen a profusion of

this growth. When the life of any tissue or membrane begins to wane, then the process of death sets in, by the multiplication of these fungi, to repair in some way the destruction going on in the diseased parts. Their first and last mission is growth and reparation of the wasted tissues, and because they are seen so late in disease in such frequency, only shows how lavish nature is to restore health in the affected parts. "The forms of bacteria are only the latest degrees of organization, and stand on the confines of animal and vegetable life." They are not individually injurious, but when numerous in the blood vessels they may be accompanied by a decomposition of the blood and secondary symptoms of poisoning. They are not probably the cause, but attendants of these pathological changes.

But there are other strong objections to the validity of the bacterian theory. If these vegetations were found in diphtheria alone, then there might be some reason in the supposition that they originate it, but they are noticed elsewhere. They are often recognized in puerperal endometritis; in inflammation of the lymphatic glands; in pulmonary abscesses, and abscesses of other organs; in serous inflammations, and puriform thrombi of the veins. Jones and Sieveking state that they are observed in suppurative, nephritis, and putrefying urine. Ricklinghausen has observed them in pyaemic abscesses. Bundon Sanderson has traced similar organisms in the fluid of a large class of infective inflammations. Cohn maintains that, "all putrefaction is attended by the development of bacteria." Tendency to decay, or necrosis of the parts, gives an increase of these vegetations.

Again, another objection to the bacterian theory lies in the fact that certain meteorological changes (their nature being as yet obscure), the prevalence of influenza and common sore throat during an epidemic of diphtheria, would indicate a different origin. Then the sequelae of this affection, viz: paralysis, would show that its poison and septicaemia are quite distinct, for persons who have septicaemia often recover and are in no way troubled with paralytic affections. Besides, it is well known that these fungi remain a long time in the mouth, cover the teeth and gums, without interfering with the ordinary functions of the system, and it is quite improbable that their nature is so suddenly changed as to produce

a dangerous disease. Moreover, if these bacteria are from without the body, why do they seize first the facial regions, passing over other portions of the mucous membrane just as well adapted for the nidus of vegetation? The larynx and nasal passages are seldom at first the place where the pseudo-membrane is first found.

In addition, there is no doubt that constitutional symptoms precede the local manifestations of the throat. In the epidemic at Groveton, N. H., in 1878, for days patients began "to droop," to be in a weakened state, as if under the influence of some poison that was permeating the entire system, and then followed the usual phenomena of the fauces. In an epidemic of 1878, I noticed quite a number of cases where the patients complained of sore throat and difficulty of swallowing, and on inspection no membrane was seen for hours, and in one case, for two days. In these cases there could be no question that the inflammation was developed in consequence of blood poison, and not from any irritating fungus upon the mucous surface. There is nothing more frequent than the occurrence of severe constitutional symptoms, for a half day or longer, before the usual inflammation ensues or the membrane is seen.

Again, the sudden deaths in this disease would preclude the supposition that their cause was derived from local absorption. Cases are reported terminating the first day of the attack, and also there are cases where the membrane is so small in extent that the cause of death could not be due to diphtheritic toxæmia. The only explanation of such instances is, that the first departure from health is in the blood. The hypothesis that the small, and oftentimes harmless local appearances of the mucous membrane, is the source of such morbid changes as is frequently met with in diphtheria, seems, at least, not grounded upon reason. The following case will illustrate this point: G. E., aged seven years, was sick with diphtheria in the winter of 1878. She complained, at first, of soreness of throat and a slight difficulty in swallowing. She was able to be about her room. There was no odor, no enlargement of the cervical glands, nor any of the usual concomitants of diphtheria. Pulse 125; temperature 101°; appetite variable. The second day, towards evening, there was a slight patch over the left tonsil, about six lines in length and five in breadth; breath slightly

offensive ; temperature 102° ; pulse feeble and quickened. There was no dyspœa, nor was the larynx involved. All nourishment and medicines were refused. She sank rapidly on the third day with such slight diseased membrane as to make it impossible to produce general septic symptoms. Her disease was constitutional from the first. The poison prostrated her vital powers, and she was unable to withstand the severe attack upon her system. There was albumen in the urine, another indication of the constitutional nature of diphtheria.

Let us here remark that a few observers have met with albumen as early as the first day of the disease, and nephritis begun as early as pharyngitis. This fact would tend to show that the miasmatic poisoning must have entered the blood before the renal disturbance.

One other objection to the bacterian theory is, that diphtheria is oftener a disease of cold climates. It is seldom noticed in the warmer regions of this country, away from the changeableness of ocean breezes. If it depends upon external vegetation for its growth and extension, then the inference would be that it would prevail more extensively where warmth and suitable surroundings for miasm exist ; but its history does not teach this.

With what is known in regard to bacteria, the general conclusion is that they are the attendants of putrefaction, and not the specific principles of diphtheria ; that in no way, at first, do they harm the ordinary functions of the body. Possibly, as death nears, they may serve to obstruct or divert the normal course of nutrition, and, by entering the blood and lymphatic vessels, interfere with their ordinary offices. If bacteria could be discovered externally to the body then they might become bearers of infection, but research has failed to verify this.

CAUSES.

Predisponents. The predisposing causes of diphtheria are tender age. Childhood is more subject to it than any other period of life. In Gloucester, Massachusetts, in 1877, out of 207 fatal cases, 146 were children less than five years of age. In Taunton, the same state, in 527 cases, there were 93 deaths, as follows :

From 1 to 3	39
“ 4 to 6	33
“ 7 to 10	15
“ 12 to 36	6
	—
	93

In England, from the returns of Registration General (London Lancet, 1878), there is an analysis of 70,000 fatal cases. The proportion of deaths in one thousand is as follows :

Under 1 year,	90
From 1 to 5	450
“ 5 to 10	260
“ 10 to 15	90
“ 15 to 25	50
“ 25 to 45	35
“ 45 upwards,	25
	—
	1000

By this table, it will be seen nearly one half of the mortality occurs before five years of age, and four fifths under ten. It rarely occurs in children under one year. Cases, however, are reported of children three days old. Old age is comparatively exempt from its attacks, and it is not frequent after the middle of life. But persons in the vitiated air of the sick room, are especially liable. Next to age, among those predisposed to diphtheria, we may mention those who are subject to pharyngeal catarrh, and those who have had diseases which have lowered the vitality of the system ; those who have inherited weak constitutions, who are afflicted with enlarged tonsils, glandular swellings ; the scrofulous, and those who have “relaxed throats,” or where the epithelium is in an irritated state, as especially prone to the disease. In addition, persons having insufficient food, or badly nourished, or debilitated from over work, abstinence, indulgence, or living in ill ventilated houses, or crowded into tenements uncleanly, with a foul and tainted air, are its subjects. Sensitiveness to the contagions of diphtheria, varies in the same individual in different seasons of the year. Also, great differences exist in susceptibility to the disease ; many children pass through epidemics and go unharmed

from the poison. The influence of schools favor its extension, epidemically, and so do crowded assemblages.

ATMOSPHERICAL INFLUENCES.

There can be no doubt that certain meteorological changes affect or modify the prevalence of diphtheria. Its existence is mostly confined to the temperate climate, and it is seldom found in the frigid regions. The nearer the tropics the less it is known. Occasionally it appears there, but if so, it is in a less virulent form. Its natural *habitat* is when there are sudden vicissitudes of weather, as, for instance, from cold to mildness, from dryness to dampness; transitions from heated rooms to a lower temperature, or any state of the air which tends to produce hyperaemic conditions of the naso pharyngeal mucous surfaces, favor its growth. It exists more in the autumn and spring than in the summer months. From the middle of August, it begins to increase up to about the middle of November. Dr. Snow, of Providence, R. I., reports (*Vital Statistics of Providence, R. I., 1878*) a larger fatality in October, and in that city in the last four months of the year more than half of the number of deaths occur. From 1858 to 1878 the aggregate mortality in October, November and December, was 41.59 per cent. Similar results have been noticed in other places. In Lynn, Mass. (*Massachusetts Report of Board of Health, 1878*), out of 509 cases in 1877, over 23 per cent. of these were in October. This month was several degrees colder than usual, with an excess of dampness. In Taunton, of the same state, of 527 cases, 161 were in the same month. In Wilmington, Del. (*Vital Statistics, Wilmington, Del., 1878*), the disease was more prevalent in the cold months. No deaths occurred in that city in 1873, from June to October; and in 1875-6, none from March to September. We have noted more diphtheria the last of October and the first of November. Webmer, of Germany, shows a greater predominance in autumn, especially from September to December. In an epidemic in Berlin, from 1868 to 1869, extending from November to April, it reached its height in the very rainy month of November. Diphtheria, like kindred diseases, is not confined to any rules, but during an epidemic breaks over all barriers. In Gloucester, Mass., the greatest mortality was in January, 1877. This may be re-

ferred to the sudden variations of temperature likely to occur near the ocean. The observations of Dr. Thursfield are that the winter months favor its extension more than any period of the year. The terrible devastation of this scourge in Russia, during the latter part of 1879, show that changeableness of autumnal weather and the coldness of winter act as prominent exciting causes. Dr. Manson, of Maine, says that cold winter weather, followed by a warm, moist atmosphere, almost invariably grows a crop of diphtheritic patients. Florida is noted as a health resort, and for its mildness and evenness of climate. Dr. F. D. Lente, of New York, who spends his winters in that state, writes, "Diphtheria has never prevailed there." Of its existence in an epidemic or sporadic form in the warmer parts of the year, there is no question, but the occasion of its appearance will be in the hygrometric state of the air, or from sudden meteorological changes. A low temperature, associated with marked humidity of the atmosphere, is more favorable to its increase and high mortality than any other condition. In proof of atmospherical influences, Mr. Salter, of England, states that he has been suddenly called to three or four cases of diphtheria in one day, at the distance of ten or twelve miles apart. The larger the amount of rain-fall in autumn and winter, the greater the predisposition to the disease. The poison of diphtheria shows less power of active diffusion in hot or cold dry air. Its normal medium is moisture accompanied by a variable temperature.

Geological Formations. There is a general agreement among all observers, that diphtheria is seen in all kinds of soil, in elevated regions as well as those of lower formation. But it is quite well ascertained that original cases never spring up in any kind of soil if the sanitary conditions are unexceptionable. The reason why so many err in this respect is, that cases are often found in healthy localities whose origin was miles away, either from infection or contagion. Because a case of diphtheria is seen, it is no evidence that its seeds or germs were in that particular place or locality. If the land is badly drained, or saturated with constant percolations of the debris of sink drains, &c., then one may safely affirm that any kind of soil, be it dry or moist, high or low, will pretty surely witness instances of the malady. Under these circumstances diphtheria exists in all geological conformations, in the undulating

prairie, in the high pine regions of Alabama (Dr. Smith, Platts-ville, Alabama), amidst the granite hills of New Hampshire, by the sea shore, valley or ravine. Quite often it breaks out in places high above the adjoining country. Take, for instance, Lexington, Ky., one thousand feet above the Gulf of Mexico, and five hundred feet above the city of Louisville, of the same state. In the former place, a few years ago, it appeared epidemically, while in the latter place they were only sporadic cases.* Dr. McClelland, of Illinois, states that at Peoria, and adjoining territory, where the general features of the country are that of a level plain, it manifests itself frequently in a malignant form. This much is proven: that diphtheria clings to those soils where there is a decay of vegetable matter, in undrained marshes, in localities by the side of stagnant waters, on hill or valley where filth reigns, where externally everything bespeaks comfort and opulence. Soils free from the contaminating influences of filth, never witness, *de novo*, a case of this disease.

Filth. Diphtheria is a filth disease. This can be as clearly demonstrated as that typhoid fever is thus derived. Taking into consideration the varieties of soil, conditions of life, and other phenomena of this disease, this view meets all of its peculiarities and better explains its history than any other hypothesis. This statement does not rest on mere assertion alone, it is accompanied by such accumulation of proof as would substantiate the origin of any other disease. We are aware that there is a strong objection to this opinion, because there are families and individuals living in filth, constantly taking into their lungs impure air, and yet they do not contract diphtheria more than those in sanitary situations. No one believes that any and every kind of foul emanations from decomposing matter, will at all times inaugurate this ailment. There must be local and atmospherical conditions to set into activity its poison. Every fetid odor is not laden with the seeds of disease, nor with the particular infecting matter which excites in the system such grave consequences. Those families and individuals living in such unnatural circumstances, may not have been subjected to its contagion, but when they are, they will fall more easily a prey to its ravages.

* This information was obtained from Dr. Hewit, Louisville, Ky.

What we mean by filth, is that state of things in houses, and the soil around them, which would suggest demand for drainage. The term is applicable to the effluvia of over-crowding ; to the foulness of air occasioned by the removal of volatile refuse matter of the body ; to those places where, for the want of proper ventilation and the exclusion of light, unhealthy vegetations spring up ; mould and decay are seen, and odorous gases arise ; to houses with unventilated cellars, where decomposition of animal and vegetable matter has contaminated the soil and air ; to stagnant waters, often the receptacle of sink drains ; to wet and marshy lands, cess-pools, along the side of which is placed many a dwelling. The foulness of water in such places, and the tainted atmosphere, contain the seeds of current morbid infection, and render all connected therewith subjects for disease. It is in such localities that we often see diphtheria in its worst forms. The causative agent is developed and reproduced external to the physical organization.

There is no disease without an adequate cause. That filth is one of the latent causes which induces diphtheria may be inferred from the fact that it is often noticed independently of antecedent causes. Quite often it breaks out in isolated districts, in habitations miles away from others, and in some instances appearing in lonely spots, amidst elevated regions, where a visit from others would be a circumstance too important to be forgotten, and of course the disease could not originate from contagion or infection, for the persons attacked were children whose movements could be traced with the strictest accuracy, where, after the most careful scrutiny, no instrumentality could be discovered to explain its outbreak, except the surroundings of the dwelling, whose privies and sink drains were badly cared for. During last November, I met with four virulent cases of diphtheria in a farm house situated about half a mile from any other dwelling. On the east of this house was a stable used for a slaughter house ; on the west, a wooden sink spout, untrapped, poured its contents into a drain. This drain was covered for about two rods, and then it opened and the waste water ran upon the top of the ground. The first case was a youth of sixteen years, who slept in the south-west corner of the house, in a small room near the waste water. There had been no cases of diphtheria in the neighborhood. Indeed, these four

cases were the only ones for the season. There was no doubt of the spontaneous origin either from the stable or drain. In November, 1878, several cases of diphtheria originated at a small school-house in Dover, N. H. Seven of these (many of them living a mile apart) were seized nearly at the same time, within a few hours of each other. The origin of this epidemic was traceable to the privy of the school-house, which had not been cleaned for three years. The soil was moist, and in the spring of the year water from melting snows and rains often stood around the house, and of course the soil was saturated from soakage of the privy contents.

There can be no doubt that sewer gas bears an important part as one of the factors in generating diphtheria. Water-closets are often constructed imperfectly and more or less mischievous, so that this gas enters buildings. They are by no means perfect, unless the flow of sewage be continuous without leakage or deposit, and in absence of this, of course they become sources of disease. There is a carelessness in constructing house drain receiving pipes, so that often communication is brought therewith into the interior of houses, actually within bed rooms. Water-closets do not often have suitable means for flushing. Many a dwelling is filled with impure air from mismanagement of drain outlets, or non-repair of worn out apparatus, or from sink traps injudiciously made, or from accumulating privies. The breathing of this impure air is most deleterious, because in sleep the respiration is fuller and more free, and there is not so much circulation of fresh air as in the day time. The consequences of this are to render the system more subject to disease, and if these drains are in populated places, they afford means to carry the disease far and wide, and produce epidemics. But sewer gas is not the sole agent, and it may not be the hot-bed of this malady. In country places there can be but little anxiety from this source, as but few houses are furnished with sewage apparatus, and yet the disease is quite as dominant there. How often, just outside of many a dwelling, one sees "refuse matter in the state of decomposition, excrements of man and beast, garbage of every kind, ponded slop water lying on the surface of the ground, sometimes in absence of drainage held specially in receptacles provided for accumulations." All these substances will carry volatile effluvia into the air, and by soakage

and leakage into the soil send forth foul and sickening influences to weaken those who live amid their disease-giving powers. These, with the decay of vegetable and animal material in certain states, are necessary for the production of this disease, depending as much on the rate of temperature, and their decomposition, as on the character of their ingredients.

But filth often exists in habitations where there is no ventilation underneath—where the air, through decomposition of organic matter, often becomes noxious and irritating to the nasal and pharyngeal mucous surfaces. This is caused by locating buildings without adequate cellars, or none at all. Free circulation under a building is an important requisite for the maintenance of health. Quite often houses are built with open floors, where families live and spend most of their social intercourse. In the washing of these floors filth and vegetable matter fall underneath, and eventually the soil becomes permeated therewith. We learn from a gentleman who has resided a long time in Russia, that the poorer classes live in cellarless houses, with floors not sufficiently closed, and where much of the filth of living drops down underneath them. These rooms serve as sleeping rooms, where quite a number, often as many as ten or more, sleep and breathe the vitiated air of such tenements. Doubtless the great prevalence of diphtheria in that country, in 1879–80, is partly due to this manner of living. No one can imagine the offensiveness of this pent up air of buildings thus located, where no opportunity is given for escape. The odor is pungent and irritating, and persons brought under its influence must be severely affected therewith. It is from buildings of this character, contaminated by the effluvia of vegetable and animal decay, that have drawn the attention of physicians to the fact, that diphtheria is quite often prevalent in houses or rooms with no cellars, or in houses which have, by reason of age or carelessness of location, settled into the ground and thus preventing the free circulation of air underneath. The observations of Dr. Field (*see N. Y. Medical Record, 1875*), of Iowa, upon this point, are quite interesting and instructive. His conclusions in his investigation of the condition of twenty houses, are that ground and cellar air furnishes some of the conditions or essential elements for the origin of diphtheria.

Then another source of filth is found in the water supply from springs and wells. Often these are fed from surface water which gathers up all the filth for miles around, from hill and mountain, to be poured into them, and into ponds and lakes, and even into running streams. This is often carried far and wide by the ice formed in such localities, for it has been found that the act of freezing does not destroy the activity of vegetable or animal matter to produce serious disturbances in the human system. The singular and instructive cases of intestinal disorder, which occurred at Rye Beach, N. H., reported in the Seventh Report of the State Board of Health, illustrate the possibilities of impure ice used in drinking water to become mischievous to health. If diphtheria is obtained by impure water of wells and the contamination of springs through a filthy influx of surface water, we can see no reason why it may not propagate itself sometimes through ice. Indeed, the history of the disease, its mode of origin and the laws which govern its progress, would tend to the probabilities of this supposition.

The influences of filth are seen whenever ponds or marshes are drained, and where the refuse of these are exposed to the sun and air. Take, for illustration, the epidemic (*see N. H. Medical Society Transactions, 1879*), in New Hampshire, 1873, where there were 114 cases of diphtheria in a sparsely populated town. This broke out in a school house which was situated near a mill pond and a marshy piece of land made up of decayed vegetable matter. Little water courses ran down from the hill-side, one of which made its course under the school house. In addition, there were two privies whose contents had not been removed for two years. Besides, the refuse of a tannery and the sawdust from a saw-mill was carried down into the pond and marsh. Just before the outbreak, the water was drained off for the purpose of repairing the dam, leaving exposed the bed of the pond and the partly drained marsh. Twenty-seven members of the school were stricken down in a few days, and there is but little question that filth was the primary cause. A singular fact about this epidemic, and pointing to the bottom of the pond and marsh as the factors, is, that old and young living around this locality complained of fatigue, chills, loss of appetite, approaching a typhoid condition. Typhoid fever followed this epidemic. After the reparation of the dam the gates

were closed and then all at once the village became free of disease. (*See Appendix for illustrations of the effects of filth as a cause of diphtheria.*)

Symptoms. These vary from a slight soreness of the throat with but little fever, to those of a most malignant type. Many writers * have attempted to classify the different phases of these symptoms, and denominated them under different names. There is no sharp distinction between these supposed varieties, for they often run into each other. A mild case may become a malignant one. We shall consider only two varieties, the mild, with but little constitutional disturbance, and the malignant, where there is serious trouble in the vital functions of the body, where the system seems prostrated under the heavy load of blood poisoning. The characteristic symptom attending both forms is the pseudo-membrane. This generally, but not always, points to the true nature of the malady. In the mild variety, the symptoms which commonly precede, and which may continue from two to five days, are dullness, headache, anorexia, moderate febrile action, where the temperature may rise a degree or two above normal. The symptoms are simply those of common sore throat, with a feeling of dizziness and some slight difficulty in deglutition. There is a general sensation of depression, accompanied with pain in the loins, dizziness, nausea, and occasionally diarrhoea. Very often the patient is about the house as if affected with a slight cold or some trivial sickness. The tongue has a dirty, pasty coat; the throat is of a reddish hue, not unlike the appearance of pharyngitis; the uvula is enlarged and elongated, and the posterior part of the fauces and tonsils are red and swollen. Sometimes only one side of the fauces is affected. The cervical glands are tender and larger than usual, and are swollen on the side of the inflamed part. In a short time the membrane appears. This generally commences with whitish spots, patches or shreds, and these patches are surrounded by a bright red border, gradually becoming thinner at the edges, and after a while coalesce and form a complete covering to a part, or the

* Dr. Jenner has grouped the different varieties into six, as follows: 1. The mild form of diphtheria. 2. The inflammatory forms. 3. The insidious forms. 4. The nasal forms. 5. The primary laryngeal form. 6. The asthenic form, and some have added the gangrenous form, and a chronic form. These names indicate the symptoms which may be expected in each variety.

whole of the faucial region. Sometimes the tonsils are engorged and fill up the entire passage. The membrane presents a variety of shades of color, from a pure white to a darkish tint, and looks like wet parchment. Now and then, after the disappearance of the membrane, the parts become speckled over with small white cheesy spots, but they generally disappear without further inconvenience. This membrane is not confined to the pharynx alone, it may extend to the nares and involve the nasal passages, causing a muco-purulent discharge. This is always considered a grave symptom. Frequently the disease travels down into the trachea and bronchial tubes, and, in fact, no part of the body is entirely exempt from its presence, if there are wounded surfaces or the skin is denuded by burns or other injuries. When the disease reaches the trachea, there is hoarseness, the voice loses its resonance and dwindles down to a mere whisper. The pulse is more frequent, and febrile symptoms are more pronounced, with dyspnoea, irregular respiration, and attacks of suffocation. Inspiration is hurried and performed with difficulty. Vomiting relieves this distressing symptom, but it is of brief duration; the lips become purple, and there is paleness or a mottled appearance of the face.

The external symptoms are swelling and stiffness of the muscles of the neck, so that the enlargement often becomes even with the face. An efflorescence is frequently observed upon the skin, very much, in some cases, like scarlatina, but it is of shorter duration. Exanthems often appear over the face, chest, and abdomen. These are raised, have a rough appearance, and disappear upon pressure. In extreme cases there is excessive pallor of the whole surface of the body, and absence of heat.

In the malignant form, the symptoms are more marked and aggravated. The disease is ushered in with severe headache, especially in the crown of the head, pain in the back and ear, vomiting and epistaxis, and severe rigors. The pulse is small and weak and irregular; deglutition becomes impeded, and yet the throat symptoms are not severe. The patient complains of an unusual sense of oppression and debility, and there is a most intolerable fetor, strongly marked and distinguishable as the odor of variola. Often restlessness or drowsiness are seen, dullness of mental faculties, and in a few cases, coma. The eyes are

heavy and watery ; the skin has a cold and clammy feel ; the sphincters are relaxed with involuntary discharges, and often petechiae are seen over various parts of the body. The face is pale, shrunk ; the internal fauces appear of a dark color ; the tongue dry. There is the appearance of profound blood poison,—delirium supervenes, and the sick die in a comatose condition, or are suddenly taken with paralysis of the heart. Sometimes cases of malignancy creep on deceitfully,—begin as mild cases and end in the severest forms of the disease.

The fever which ushers in diphtheria is not in all cases marked, nor is it of much prognostic importance, for, in light attacks, the temperature may rise to 104° or more, while in severe malignant cases it is quite low ; we have noticed it at 98° F. Generally it arrives at its maximum point about the fourth day, and then it begins to decrease, until it falls to nearly a normal state. Usually there is more heat in the night than in the daytime. If some new complication starts up, there is often a sudden rise of temperature denoting some local trouble, or it has some relation to the extension of the malady or putrefactive changes in the membrane. A gradual increase or decrease does not always betoken a favorable or unfavorable issue of the affection. Wunderlich believe that the temperature in diphtheria has but little prognostic value, while other observers, as Faralli and M. Labadie Lagrave, maintain that the thermometer furnishes data for diagnosis and prognosis. There is but little doubt that fever is commonly present, but the usual manner of obtaining the temperature does not always indicate its presence, or the lightness or gravity of the disease.

In slight forms of diphtheria, there is no irritation of the kidneys, or trace of albumen, but as the disease becomes more severe, we find the urine highly colored, and of high specific gravity. In some instances there seems to be a partial absence of this fluid. The urine generally contains an excess of urea, and the microscope reveals hyaline, granular and epithelial casts, together with uric acid, oxalates, and urates ; and occasionally phosphates are detected. Albumen, first pointed out by Dr. Wade, of England, is a frequent but not a constant attendant. It is an early symptom, sometimes occurring at or near the outset of the pharyngeal or laryngeal symptoms, but it may be delayed for many days. Its

presence may be intermittent, for it often disappears and reappears before convalescence sets in. Nor does the severity of symptoms indicate its existence, for it has been searched for in vain in malignant cases and been detected in the mildest attacks. Erberth, of Germany, states that two out of every three are affected with albumen. It generally continues throughout the disease until convalescence is established. Some few observers have considered it a dangerous symptom, but the preponderance of evidence is to the contrary, and that it has only a "limited significance in relation to prognosis and treatment." It is scarcely ever followed by any complications, such as anarsaca or uraemia. It is seldom noticed as one of the sequelae of recovery.

When the disease is inclined to terminate favorably, there is a subsidence of the general and subjective symptoms. The fever yields, the temperature of the body falls to that of health and sometimes below; the pain in the throat, in swallowing, diminishes; the tongue clears, the appetite improves; the urine becomes more plentiful, and the signs of exhaustion, often noticed, yield. The duration of diphtheria generally is from ten days to two or three weeks; but after convalescence has been comparatively established, then certain sequelae of diphtheria, such as paralysis and debility, often follow. These sequelae do not depend upon the virulence of the disease, for they may arise in any case, however slight the attack. Nor does the paralysis affect patients alike; in one case it may be partial, or confined to a single muscle, or there may be a complete paralytic condition of several muscles. The mucous membrane, naturally sensitive, becomes insensible. The most general locality for this paralysis is the soft palate and larynx. The sensation and motion of the tongue and lips often become affected. The bladder, rectum, and the contour of the face are not often involved. When paralysis seizes upon the muscles of the pharynx, there is an inability to swallow drinks; they regurgitate and pass into the nose, or sometimes down into the larynx. Dysphagia is not uncommon. The taste is blunted, the power of expectoration lost, speech becomes nasal, the eye-sight is impaired so that fine print cannot be read, and the accommodation of the eye is deficient; the extremities have a sense of feebleness and coldness; tingling, formication and numbness, with sharp pains in

the feet, are experienced. The muscular system is often largely involved, so that the muscles become flaccid and without tone, and there is not the usual sensation of touch. These paralysis of different parts of the body signify partial lesions of the nervous centres. Sometimes other nervous troubles arise and continue for months after convalescence has begun.

Diagnosis. Diphtheria is generally recognized by the characteristic membrane of the fauces. Perhaps nine tenths of patients have this, and therefore the diagnosis is not difficult. But there are cases where there is so much deviation from the normal type, as to make it not easy to form a correct opinion of its true character. Inspection does not aid, for there is no membrane, or it is delayed in appearing. Then some are struck down with blood poisoning, and a typhoid state follows so quickly that diphtheria may not be suspected. In doubtful instances, one can be assisted in his conclusions if he take into consideration the character of the epidemic,—whether the disease has been in the building, or near the locality, or whether there has been exposure. The nature of doubtful cases is assured if the disease spreads or others become sick through contagion and infection.

But diphtheria may simulate other affections, as scarlet fever, tonsillitis, or pharyngitis, or confluent herpes, or follicular inflammation of the throat. The difference between scarlet fever and diphtheria is, in the former there is a deeper redness of the fauces. The constitutional symptoms are more severe, and if there is any membrane it is softer and easily detached. In tonsillitis, aside from the fever, there is extensive congestion and more or less unilateral tendency, as in diphtheria; but this affection subsides in a few days, or passes into suppuration, and then, of course, all doubt is removed. In confluent herpes, there is opportunity for mistake. No doubt affections of this character are wrongly classed as diphtheria, or how can we explain the apparent success of one physician, and the total failure of another, in their treatment of reported cases of this malady. One cures his cases with one remedy, and another is equally fortunate with something totally different; but when a typical case is met with, their boasted remedies are found to be useless. In this class of cases there is constitutional disturbance, but this soon abates.

Then there is no tendency to spread beyond its first appearance. There is considerable tenderness, on pressure, just at the angle of the inferior maxillary bone. The uvula and tonsils are tumefied, and of angry red color, while on their surface small irregularly shaped yellowish white spots will be observed. These spots are evidently of an aphthous nature. There may be only one or two on the tonsils or uvula, or they may cover very thickly the soft palate. They do not often coalesce, or form patches. They yield to a simple wash of tincture of iron, or chlorate of potash. Often there is considerable prostration and muscular debility, but no paralysis or albumen. A patient having had this trouble may be subsequently attacked by diphtheria.

There is one other affection of the pharynx that may be mistaken for diphtheria, viz. : follicular pharyngitis. Here, there is an exudation of small whitish spots over the follicles of the mucous membrane. Some of these may unite together, but as a general rule these are so discrete as to establish their true character, and then they are of short continuance.

If one is attacked with pain in the back, swelling and tenderness of the cervical glands, stiffness of the neck, albumen in the urine, prostration of strength, hurried respiration, fetor of the breath, or if there be the characteristic symptoms of laryngeal trouble, affecting the voice and speech, then the disease may be diagnosed as diphtheria. Some one of these symptoms, however, may be absent and yet the disease exist.

Prognosis. Previous good health renders the prognosis more favorable, while debilitated persons, or those weakened by disease, hereditary or acquired, or excess of any kind, are wont to succumb to the virulence of diphtheria. In mild cases, without much membrane, where there is slight fever, and little swelling of the fauces and glands, a majority recover without treatment. But the prognosis is often uncertain, and a positive result cannot be predicted, in any given instance, for cases seemingly mild at the outset may terminate disastrously, or relapses may take place after the subsidence of alarming symptoms, and death may occur at any moment. If the patient is young, the result is always in doubt; and then, absence of fever does not assure the case as free from danger. There may be complications in the disease, as measles,

scarlatina, pneumonia, etc., which would render the result more unfavorable. The dangers of diphtheria are, its extension to the larynx and trachea and nasal passages, severe blood poisoning, sudden terminations of the disease by syncope, paralysis of the heart, septic poison, and as a consequence, an asthenic condition of the system. It is estimated that in severe malignant cases nearly one third die. The usual symptoms foreboding danger are refusal to take food, frequent vomiting, coldness and dryness of the skin, feebleness of the heart, hiccough, countenance full and bloated, pulse small and tremulous, breathing hurried, interrupted with sighing, urine very highly colored and turbid, the fauces of dark livid color, and an eruption of purplish blotches on the skin, or irregular cutaneous rashes. But all these symptoms do not show themselves in every fatal case. Sufficient, if several of them are noticed, to denote the malignancy of the disease. Cases of fatality come on now and then insiduously, where all the symptoms are seemingly favorable, and the phenomena of the disease are mild from the first.

A more favorable prognosis can be predicted if the disease appear at the end of an epidemic. Diphtheria is most fatal on its first appearance as an epidemic, gradually becoming less dangerous after a while.

Treatment. From the nature and causes of diphtheria, there would seem to be two indications for its treatment, that stand out more prominently than any others, viz. : to husband and support the strength of the patient, by all available means, and adopt such local and general remedies as will prevent poisons to the system from the necrosed pharyngeal, laryngeal membrane. All treatment of this malady, however varied the theories as to its character, generally agree in this respect. The believer in bacteria addresses local applications to the faucial region with all the energy possible, from fear that blood poison will emanate therefrom ; and those who maintain the pharyngeal manifestations to be one of the results of a constitutional infection, resort to topical applications to prevent septic influences. The treatment usually advocated may be then divided into constitutional and topical. The means used to meet the first are few, and generally agreed upon by the pro-

fession, while the local remedies recommended are many and varied.

First Constitutional Treatment. At the outset, we would remark that all the surroundings of the sick room should be commodious, cleanly, and cheerful, with good ventilation and with a temperature of 68° F. There should be every facility to give the patient pure air, and accordingly all offensive excretions should be removed as soon as possible. The diet should be supporting and nutritious, both albuminous and farinaceous in form, such as a plenty of milk, with lime water if there be nausea or irritation of the stomach, beef tea in a concentrated form, eggs, milk, wine jelly, and other food of a light, digestible character. Often there is distaste for food on account of the difficulty in deglutition. In such instances it is the imperative duty of attendants to give due attention to nourishment, in spite of every difficulty. No existence of feverish symptoms should for a moment be an excuse for placing the patient on a "low diet." Death often results from inattentive nursing, from an unwillingness to press the listless sufferer to take the prescribed supplies of food. It seems to be an integral part of this affection to reject nourishment. But, notwithstanding this, the feeding should be systematic and at regular intervals in the night as well as the day time. If it cannot be retained, then nutritious enema should be employed, such as beef tea, and milk with wine. Next to nourishment comes the use of alcohol in some of its different forms, as giving the sick one the best chance to overcome the prostration of the disease. At first, only small quantities are demanded. No doubt there are cases where it is unnecessary to use stimulants at all, but when the chance of saving life is at stake, there should be no scruples in their employment, and they should be pushed with vigor. M. Sanné in his recent able work on diphtheria, says: "Of all the antiseptics given internally, alcohol is the surest. The more the infection is pronounced, the more it is necessary to insist in the use of alcoholic mixtures." In some cases, large doses seem to be required from the commencement of the attack. High temperature does not forbid its employment and when there is feebleness of the heart, a slow pulse, attacks of delirium, syncope, symptoms of extension and prostration, pinched features of the counte-

nance, and a shrivelled state of the skin,—these denote the severity of the malady, and stimulants should be given freely. It is astonishing to see what large amounts of alcohol are readily borne, without producing even odor of the breath, or any excitement. It matters little in what form stimulants are administered, provided they are of sufficient strength to give the necessary support. The success of Dr. E. N. Chapman, of Brooklyn, N. Y., in the use of alcohol is quite remarkable. (“Antagonism of Alcohol and Diphtheria,” 1878, by E. N. Chapman.) He maintains that “alcohol is as antagonistic to diphtheria as belladonna is to opium, or quinine is to malaria.” His experience in the treatment of diphtheria without stimulants, is, that he lost every third or fourth patient, but after instituting an opposite treatment, when an epidemic was at its worst, he did not lose more than one in twenty. He accounts for his success in the use of stimulants, by the theory that diphtheria is a disease of the blood tending to the rapid destruction of this fluid; that the appearance of the fauces is secondary to this blood poison,—a local manifestation of a general dyscrasy; that the fever is symptomatic, and that alcohol counteracts, neutralizes, or destroys the poison,—acting like a true antidote if promptly and liberally given.” Dr. Chapman often gives quinine in connection with alcohol. But Dr. Kretzschmar (*Hospital Gazette*, June, 1879), of Long Island College Hospital, has employed alcohol alone with equal success. In one hundred and fifty-five cases reported at that hospital, one hundred and forty nine recovered and six died. No explanation as to the severity of the disease treated accompanies the report of these cases; but if they were typical instances of diphtheria, then the success is noteworthy and deserves a more general trial.

Along with stimulants are other medicines indispensable to the proper treatment of diphtheria. Quinine is one of these. If there is headache, with high temperature, or vomiting, or symptoms of septicaemia, then this holds a prominent place. It should be given in small quantities, repeated every three or four hours. We would not advocate the custom of administering it in heroic doses as is the habit of some. As a heart tonic, or in enfeebled states of the system, to improve the appetite and give tone to the system, or

in the sequelae of this disease, it affords an excellent purpose. Its long continuance in any case is hurtful.

Next to quinine as a recuperative agent, iron is entitled to consideration. We think the perchloride is the best, whether used as a gargle, or taken in the stomach. From fifteen to thirty drops in glycerine diluted with water forms a good preparation. Its effect, as a gargle, upon the sensitiveness of the mucous membrane of the throat, is often marked, relieving frequently the soreness and pain in a very few hours. Its special value internally is in the later stages of the disease, for when there is fever and a sensitive stomach, it is injurious.

A good formula in conjunction with quinine is :—

R

Quiniae. Sul. 3ss.

Tinc. ferri. chlo. 3ij.

Potass. Chlorati. 3ij.

Syr. Tolu 3jv.

Misce.

Give one teaspoonful every two to four hours, to a child of five years old.

Besides these two agents there are certain medicines classed as antiseptics, which are given internally more or less. These include carbolic acid, permanganate of potash, salicylic acid and its components, hypophosphite of soda, chloriate of potash and hydrate of chloral. Almost every medicine which has chlorine for a base, has had its advocates, and has been used in the treatment of diphtheria. It is an open question whether many of the medicines named have any direct power over the disease. Their employment is thought to counteract the destructive action of the diphtheritic poison, and we believe they are often useful. Sulphurous and sulphuric acid drinks are often grateful.

Local treatment. In the early part of the disease, ice, externally and internally, when the throat is sore, or there is a burning sensation, often relieves the anguish. Warm or hot fomentations or poultices, rubefacients, cotton waddings, &c., externally, even when

the membrane has attained considerable thickness, are beneficial. These have a tendency to modify the intensity of the pharyngeal inflammation.

The topical treatment of the membrane and throat has varied from time to time. Formerly, caustics were advocated, but they are now abandoned as having but little power over the local disease, and are, in fact, injurious. They serve to aggravate rather than check the local process; besides, if the membrane is destroyed by these, it will return in a short time. The best agents for topical use are chlorate of potash, permanganate of potash, chloroform, hydrate of chloral, glycerine of borax, sulphur, bromine and carbolic acid. There are quite a large number of others recommended by different writers. Chlorate of potash can be used very freely and almost of any strength. It is always safe. Chloroform applied directly to the membrane, by a probang or sponge, often has a very soothing effect, and produces no burning or disagreeable sensation. It often destroys the membrane and arrests the extension of the local irritation. But to prevent the offensive fetor of the breath, there is nothing more effectual than permanganate of potash, and chlorinated soda. We use the permanganate gr. V. to Ξ I of water; and the chlorinated soda \Im IV to \Im X of water.

It is imperative to use frequently and thoroughly some one of these preparations in all cases, when there is a membrane, either as a gargle or a spray. The membrane should not be forcibly removed, as there is not only great danger of injuring the healthy tissues, but it may cause much pain and suffering. The soreness occasioned thereby prevents the taking of proper nourishment.

There are certain agents which are administered best by inhalations, and have a solvent action upon the membrane. The steam of lime water is easily used and is often efficient. Dr. Cohen, of Philadelphia, recommends the fumes of lime in process of slacking, as being more efficient than sprays of lime water. Carbolic acid, salicylic acid, sulphurous acid and lactic acid in form of sprays are often useful. The room should be frequently saturated with some one of these agents, so that in every inspiration it may be carried over the local inflammation into the system.

The treatment of diphtheria in this country, as derived from correspondence with physicians in almost every state, consists in

the use of chloride of iron, alcohol, quinine, and plenty of nourishment, as general means; and as local applications, chloral hydrate, carbolic acid, tannic acid, chlorate of potash, alum, hyposulphite of soda and chloroform. Dr. Bradbury, of Maine, recommends the inhalation of the steam of a strong solution of acetate of potash; Dr. Hewitt, of Lexington, Ky., relies chiefly on salicylate of soda, chlorate of potash, quinine, stimulants, and steam inhalations night and day. Dr. Force, of Lexington, Ky., says a "supporting treatment and stimulations have proved best." He employs quinine. Dr. Bush, of Delaware, uses iodine ointment externally, with carbolic acid, tinc. ferri. chloral and tinc. cincho. co. in glycerine internally. Dr. Buddington, of N. Y., recommends a spray of carbolic acid, $\frac{1}{2}$ into 6 oz. of water, by atomization. Dr. McClelland, of Illinois, finds blisters, at the angle of the jaws, beneficial.

The treatment of diphtheria in Europe does not vary much from that in this country. Sir William Jenner commences the medication with a dose of calomel and jolap. The agents generally recommended for internal use are tinc. ferri. chlorid, quinine, and alcohol. Morphia and chloral are employed to combat sleeplessness.

The antiseptics recommended internally are iron, carbolic acid, salicylic acid and its salts, hydrate of chloral and chlorate of potash.

Expectorants are senega (which was first noticed by Dr. Archer, of Philadelphia, one hundred years ago), carb. ammonia and the balsams (copaiba and cubebs).

The local treatment recommended to get rid of the membrane, is the use of lime water, saccharate of lime, a solution of caustic potash, chlorate of potash, iron and lactic acid. The latter medicine is thought the most reliable as a solvent of the membrane. Permanganate of potash is considered useful. Some of the Italian physicians rely upon sulphur as a local agent and for internal use. Benzoate of soda is thought to be almost an antidote by some Russian physicians, given internally and as a wash.

The local applications of ice and steam are highly prized. Ice bags to the neck in the first stages are found to be agreeable and beneficial. Steam inhalations exercise a favorable influence on the local process. Oertel says the internal use of moist warmth facilitates suppuration more than any other agent.

Prophylaxis. Diphtheria is, as we have seen, a constitutional disease, and its poison operates in the system through the blood. It is diffused through exhalations of the patient by means of the air, clothing, such as towels, napkins, handkerchiefs, &c., and other things which come in contact with the sick. The disease is often obtained directly by the act of kissing, coughing, and sneezing; hence, to stop its ravages and to prevent its extension, is the first duty of the physician. It can be restrained within certain limits, as effectually as other epidemic diseases. It has a cause, and very often the cause may be destroyed and the disease prevented. To do this—

1. The sick should be isolated and no communication with them should be allowed, except from one or two persons, who should have the sole charge of the patient. As a rule, the physician and nurse should be the only persons admitted to the room. In the intercourse of nurse with others care should be taken to remove and disinfect all clothing worn.

2. Every sick room should be well warmed with a liberal supply of fresh air, plenty of sunlight, and properly ventilated. It should be cheerful; and furniture, such as carpets, needless clothing, upholstered furniture, and other things to which the poison will cling, should be taken therefrom and disinfected by carbolic acid, or ~~or~~ ^{or} *chloride* of zinc, or subjected to chlorine gas.

3. All excretions of patients, whether from the mouth, kidneys, or bowels, are dangerous and should be at once removed. Soft rags, for cleaning the mouth and nostrils, are better than handkerchiefs, and should be immediately burned, or thrown into some disinfecting fluid. All soiled clothing should be put into boiling water, or water containing chlorinated soda, or lime water, or *chloride* of zinc. All vessels for receiving discharges of patients should contain some disinfecting fluid before carried through the house. Water-closets or privies, where these excretions are thrown, should be kept clean, and daily disinfected by a solution of nitrate of lead, or copperas, or lime.

4. When death occurs the body should be placed immediately in a casket or coffin with disinfectants, and be tightly and finally closed. Public funerals should not be held at the infected house,

or elsewhere, unless the casket be hermetically sealed. It is better to keep children from such assemblages.

5. On recovery the patient should be thoroughly washed with some disinfecting fluid and divested of all infected clothing. Children should not be allowed to go to school, or associate with others, until a certificate from an intelligent physician be obtained certifying that they can do so without injury to others.

6. Rooms, and all clothing, where the disease has been, should be at once subjected to a thorough disinfection. Chlorine gas is probably the best, but sulphur fumes in closed chambers may be sufficient. After being subjected to one of these disinfectants from four to six hours, then the room should be opened, and exposed to the air and sunlight for many days. Anything that can be boiled without injury may be so treated or subjected to steam, equal 240° F. It is better to whitewash the ceilings, and wash all wood-work with water, to which carbolic acid, or chlorinated soda may be added.

The above rules apply to the sick room and its internal arrangements, but there are other things essential to check the extension of diphtheria. No doubt that antiseptics given internally are serviceable, such as salicylic acid, sulphurous acid, alcohol in some of its forms. These may give tone to the system, and help it to eliminate the poisonous miasm. But cleanliness tends to prevent and mitigate the disease. This applies to the outside as well as the inside of the house. Uncleanliness affords means for spreading certain infections. The human system cannot withstand easily the depressing influences of filth. Avoid, then, everything which depresses the vital energies, and tends to promote disease, such as impure air, impure water, crowded assemblies in ill ventilated halls. Rooms shut up for weeks, or months, from which the sunlight has been excluded, are unhealthy. These beget a dampness and an atmosphere that is apt to irritate the naso-pharyngeal mucous membrane. Every room of a house should be often open to fresh currents of air, and if possible sunlight should be freely let in to destroy the germs of disease.

Much of the origin of diphtheria arises externally to dwelling-houses. Imperfect drainage is one of the chief causes. Care

then should be used to drain grounds under and around every dwelling, to have proper ventilation of cellars, and to furnish egress to impure and foul air under cellarless rooms. No vegetable or animal matter should be suffered to decompose in or near inhabited places. All refuse matter, solid or liquid, should be at once removed. Great care should be used in the construction of water-closets and privies. They should be so located as not to contaminate the air around, and be water tight. It is requisite that they be often cleaned, and during the spring and summer months it is well to throw into them lime ashes or a solution of coperas water, so as to disinfect and prevent the issue of offensive odors.

A great danger comes from permitting sinks to pour their contents upon the surface of the ground, or into cesspools. Every dwelling should have carefully laid drains, well trapped, with proper means of ventilation into the open air. Sewers should never have uninterrupted communication with any house.

Then in regard to drinking water, there should be scrupulous care that its source and surroundings be kept free from all the contaminations of filth. Chemical demonstrations of nitrogenous compounds in water, is a warning which should never be disregarded. These impurities are caused often by surface drainage or from drains, gas-pipes, cesspools and vaults placed too near wells or springs. Wells should have access to open air and should be often cleared of impurities, and any odor or offensive taste therefrom points to danger in the use of nature's beverage. Whenever diphtheria appears, sporadically or endemically, there is a filth-cause, and it behooves parents and owners of houses to trace out its origin, and prevent its recurrence.

APPENDIX.

Illustrations from reports of physicians, in Europe and United States, of the conditions in which diphtheria is formed.

DR. JOHNSON, England: "Many instances have come to my knowledge in which fetid fecal emanations have appeared to be the direct cause of diphtheria. I look upon the occurrence of diphtheria as an indication of the necessity for a most rigid inquiry into the condition of drainage and water supply."—*Braithwait's Retrospect*, Vol. 61.

DR. TOTTENHAM: "Twelve deaths from diphtheria. Every one from foul air, or some serious defect in house drains."

MR. BATEMAN: "House drained into a cesspool. The accumulation of many months was emptied into it. Offensive smell reached the house therefrom. Three days after, four children had diphtheria."—*Braithwait's Retrospect*, Vol. 61.

MR. SALTER: "Had a great many cases traceable to sewage poisons."—*Braithwait's Retrospect*, Vol. 61.

ARTHUR RANSOM, British Med. Journal, Feb., 1875: "Diphtheria is often connected with defective house drainage, or to leakage from private cesspools."—*Braithwait's Retrospect*.

DR. CAULKINS, Report of Mich. Board of Health: "Nine cases of diphtheria in one family; well water smells and tastes bad; privy seven rods from house; no other cases of the disease in town; marshy ravine just back of house; a ditch just opened in it."

ARCADIA, Michigan: "Nine cases of diphtheria. Cellar with no ventilation,—had not been cleaned for years."

FROM MASSACHUSETTS BOARD OF HEALTH, 1876.

DR. NICKERSON, Lowell, Mass. "First cases of diphtheria were noticed here in September and October. Odor from the vaults in house No. 1, powerful; damp garden behind. House No. 2, three cases. Under the sitting room an unventilated cellar, where hens had been kept. A drain passes under the floor of main sleeping room. Smell of vault was so strong that the patient had to be removed to another part of the house."

CHARLESTOWN, Mass.: "In every case of which I have been personally cognizant, there has been found defective drainage."

BROOMFIELD, Mass.: "All cases of diphtheria have been traceable to bad surroundings, sinks, privies or damp rooms."

EAST BOSTON, Mass.: "Where there are no sewers, diphtheria has been quite prevalent. In every severe case, defective drainage."

NEWTON LOWER FALLS, Mass.: "Six fatal cases. In two cases, well close to the house; surface water ran into the well."

PITTSFIELD, Mass.: "Forty-five fatal cases. Families lived in small unventilated rooms, overheated; diet inferior; sanitary defects generally outside the house."

SPRINGFIELD, Mass.: "Diphtheria evidently caused by dampness, bad water, defective drainage, no sewage."

TAUNTON, Mass.: "Causes of diphtheria are dwellings in swamps, and the use of surface or swamp water for domestic purposes; where wells are near privies and cesspools; privies not cleansed or closed; external surroundings, wet and undrained; in vicinity of night-soil deposit; stagnant ponds; cellars not cleaned, wet and filthy."

DARTMOUTH, Mass.: "Disease confined to low land surrounded by hills. Ten patients attended school in a house situated in a low, swampy place, so much so that flag grows in the yard."

GREAT BARRINGTON, Mass.: "Diphtheria occurred in old houses, with decayed timbers in rooms under which there were no cellars. Dampness and foul air had their influence in every case."

HATFIELD, Mass.: "Localities invaded: wet sinks empty on the surface; privies on the surface; drainage poor."

HADLEY, Mass.: "Six cases in a family of the filthiest horrible character; water drunk, was from a well close to the barn-yard, with half a dozen pigs in it."

GREENLAND, Mass.: "Three cases where the houses were filthy, with a swamp on the east side, and a long reach of meadow on the west."

MALDEN, Mass.: "The localities attacked have been mostly damp and marshy."

GLOUCESTER, Mass.: "Diphtheria quite prevalent. Privies are in use with loose walled vaults, which allow soakage into the ground, and consequently ground contaminations of the sub-soil and of the

wells. No water supply or sewage. Diphtheria most prevalent and fatal in the lowest, worst drained, most filthy part of the city.

DR. CHEEVER, Boston, Mass., speaks of cases of recurrent sore throat, which ceased when a defect in soil pipe was remedied.

DR. EDES, Boston: "The diphtheritic croup, he had seen, occurred in a badly drained district."

DR. HASTINGS: "Have noticed more diphtheria and typhoid fever in parts of city (Boston, Mass.) where drainage is imperfect."

DR. NICHOLS, Roxbury, Mass.: "These diseases (diphtheria and typhoid fever) are more decidedly numerous in those districts imperfectly drained, or subject to the action of sewer gas."

Such references as above found in this report could be multiplied.

DR. FRANCIS, Newport, R. I.: "Want of proper attention to hygiene; bad air."

DR. FIELD, Clinton, Iowa: "Attributes to damp cellars, unventilated, and to houses with little elevation from the ground, were 'ground air' accumulates."

DR. BUSH, Wilmington, Del.: "I believe diphtheria to be frequently the product of impure air, arising from want of cleanliness, and the emanations from privies."

DR. BLACK, Newcastle, Del., where the disease prevailed in 1879, ascribes the cause to the drainage of an extended marsh, which created an impure atmosphere.

DR. MACKIE, New Bedford, Mass.: "A specific poison, aided and fostered by filth and bad drainage."

DR. SNOW, Providence, R. I.: "Impure air coming into houses through sink spouts, or water closets, or set basins, or in any way, would naturally be more concentrated and more dangerous as the houses are more shut up on account of cold weather."

DR. PRENTISS, Washington, D. C.: "Diphtheria can be traced to unsanitary surroundings, defective sewer. This cause and contagion accounts for a great majority of cases."

DR. HOBART, Clinton, Iowa: "Defective drainage and bad sewage are the principal causes. Four years ago, one hundred cases on the borders of an open slough used as a drain for the town."

DR. LAWRENCE, Hot Spring, Ark.: "Where drainage and sewage is incomplete; water with organic filth."

DR. CONN, Concord, N. H.: "All conditions of life, but in soil in some way contaminated by filth poisoning."

DR. RICHARDSON, Philadelphia, Pa.: "Damp houses on damp soils; houses in which sewer gas enters."

DR. SHERMAN, Ogdensburg, N. Y.: "Diphtheria prevails where there is carelessness in regard to privies and drainage; emanations from decomposing matter from cesspools; slop drains, but above all, from privy vaults."

DR. McCLELLAND, Knoxville, Ill.: "In water polluted with animal and vegetable remains. I am inclined to ascribe its etiology to filth."

DR. CHAMBERLAIN, Lawrence, Mass.: "Diphtheria prefers a cold, damp soil, whose surroundings are notably unsanitary."

DR. THURSFIELD, England: "There is a specific connection between structural dampness of habitation and diphtheria, not temporary dampness or from a fall of rain."

PROF. J. L. SMITH, New York City: "The most severe cases seen by myself, occurred in the upper part of the city, along the old water courses, where, in consequence of street grading, water was stagnant and impregnated with decaying animal and vegetable matter."—*Diseases of Children*, 1879.

DR. F. P. ATKINSON, England: "An outbreak of diphtheria, caused, I believe, by the mixing of sewage contaminated water (which had been used for washing cans) with milk. It was limited to one dairy, and ceased almost immediately upon a change being made in the water."—*British Med. Jour.*, 1879.

DR. THOMAS, Savannah, Ga.: "I think it is a filth disease, though there are instances hard to account for on the dirt hypothesis. It certainly spreads more in dirty, filthy localities."

PROF. T. J. HURD, Galveston, Texas: "Soil independent of filth, I do not think, exercise any agency in producing it. Filthy apartments and the want of proper ventilation, with general insanitation, have been, according to my observations, instrumental in producing."

DR. SCOVILLE, Lebanon, Ohio: "Houses having damp and filthy cellars, decaying vegetables, have diphtheria."

DR. LESSING, Winona, Iowa: "Filthy habits, impure air and water. In a small town, eighteen miles from here, surface water was undoubtedly the cause."

DR. PUTNAM, Montpelier, Vt.: "Bad hygienic surroundings, and generally using impure water."

DR. WOODWARD, Conn.: "In damp soils, where the sewage and drainage is neglected."

